



# Bride Brook

## Watershed Summary

### WATERSHED DESCRIPTION AND MAPS

The Bride Brook watershed covers an area of approximately 3,191 acres in the southeastern area of Connecticut (Figure 1). The watershed is located entirely within East Lyme, CT.

The Bride Brook watershed includes three segments, Bride Brook (Segment 1) (CT2206-00\_01), Bride Brook (Segment 2) (CT2206-00\_02), and Bride Brook (Unnamed Tributary) (CT2206-03\_01), impaired for recreation due to elevated bacteria levels. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. Some segments in the watershed are currently unassessed as of the writing of this document. This does not suggest that there are no issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of some of the other waterbodies in the watershed (CTDEEP, 2010).

The entire length of Bride Brook is impaired (Figure 2). Bride Brook (Segment 2) (CT2206-00\_02) is the upstream impaired segment and begins at the headwaters of Bride Brook in a marshy area to the south of Route 1 in East Lyme. Bride Brook (Segment 2) flows south along N. Bride Brook Road and ends where Bride Brook enters Bride Lake in East Lyme. Bride Brook (Segment 2) is 2.13 miles long and located entirely within the town of East Lyme. Bride Brook (Segment 1) (CT2206-00\_01) begins at the outlet of Bride Lake and flows south. Bride Brook (Segment 1) ends where Bride Brook enters the estuary just downstream of the Route 156 (W. Main Street) crossing. Bride Brook (Segment 1) is 0.7 miles long and located entirely within the town of East Lyme.

Bride Brook (Unnamed Tributary) (CT2206-03\_01) begins at the headwaters of the tributary, south of Plants Dam Road in East Lyme. Bride Brook (Unnamed Tributary) flows south where it passes under I-95 before ending at the confluence with Bride Brook

### Impaired Segment Facts

#### **Impaired Segment:**

1. Bride Brook (Segment 1)  
(CT2206-00\_01)
2. Bride Brook (Segment 2)  
(CT2206-00\_02)
3. Bride Brook (Unnamed Tributary)  
(CT2206-03\_01)

#### **Municipalities:**

East Lyme

#### **Impaired Segment Length (miles):**

CT2206-00\_01 (0.70), CT2206-00\_02 (2.13), CT2206-03\_01 (1.71)

#### **Water Quality Classifications:**

Class A

#### **Designated Use Impairments:**

Recreation

#### **Sub-regional Basin Name and Code:**

Bride Brook, 2206

**Regional Basin:** Southeast Western Complex

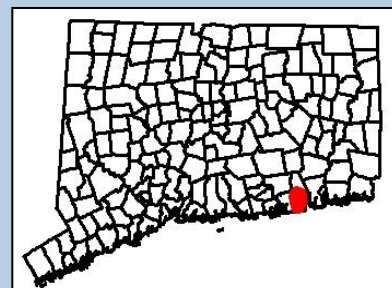
**Major Basin:** Southeast Coast

**Watershed Area (acres):** 3,191

**MS4 Applicable?** Yes

**Applicable Season:** Recreation Season (May 1 to September 30)

**Figure 1: Watershed location in Connecticut**



(Segment 1) near N. Bride Brook Road. Bride Brook (Unnamed Tributary) is 1.71 miles long and is located entirely within the town of East Lyme.

The impaired segments of Bride Brook and Bride Brook (Unnamed Tributary) all have a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in this segment of the Bride Brook, the specific recreation impairment is for non-designated swimming and other water contact related activities.

**Table 1: Impaired segments and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report**

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT2206-00_01	Bride Brook-01	From head of estuary (salt water limit, just DS of Route 156 crossing), US to Bride Lake outlet dam (just US of North Bride Brook Road), East Lyme.	0.7	NOT	NOT	FULL
CT2206-00_02	Bride Brook-02	From inlet to Bride Lake (northwest portion, just DS of North Bride Brook Road crossing), US to headwaters (marsh on south side of Route 1), East Lyme.	2.13	NOT	NOT	FULL
CT2206-03_01	Bride Brook (Unnamed Tributary) to Bride Brook (East Lyme)-01	Mouth at confluence with Bride Brook (DS of Bride Brook crossing Bride Brook Road), US (under I95 near exit 72 ramp, Rocky Neck Connector) to HW near Spring Rock Road and south of Plants Dam Road, East Lyme.	1.71	U	NOT	U

**Shaded cells indicate impaired segment addressed in this TMDL**

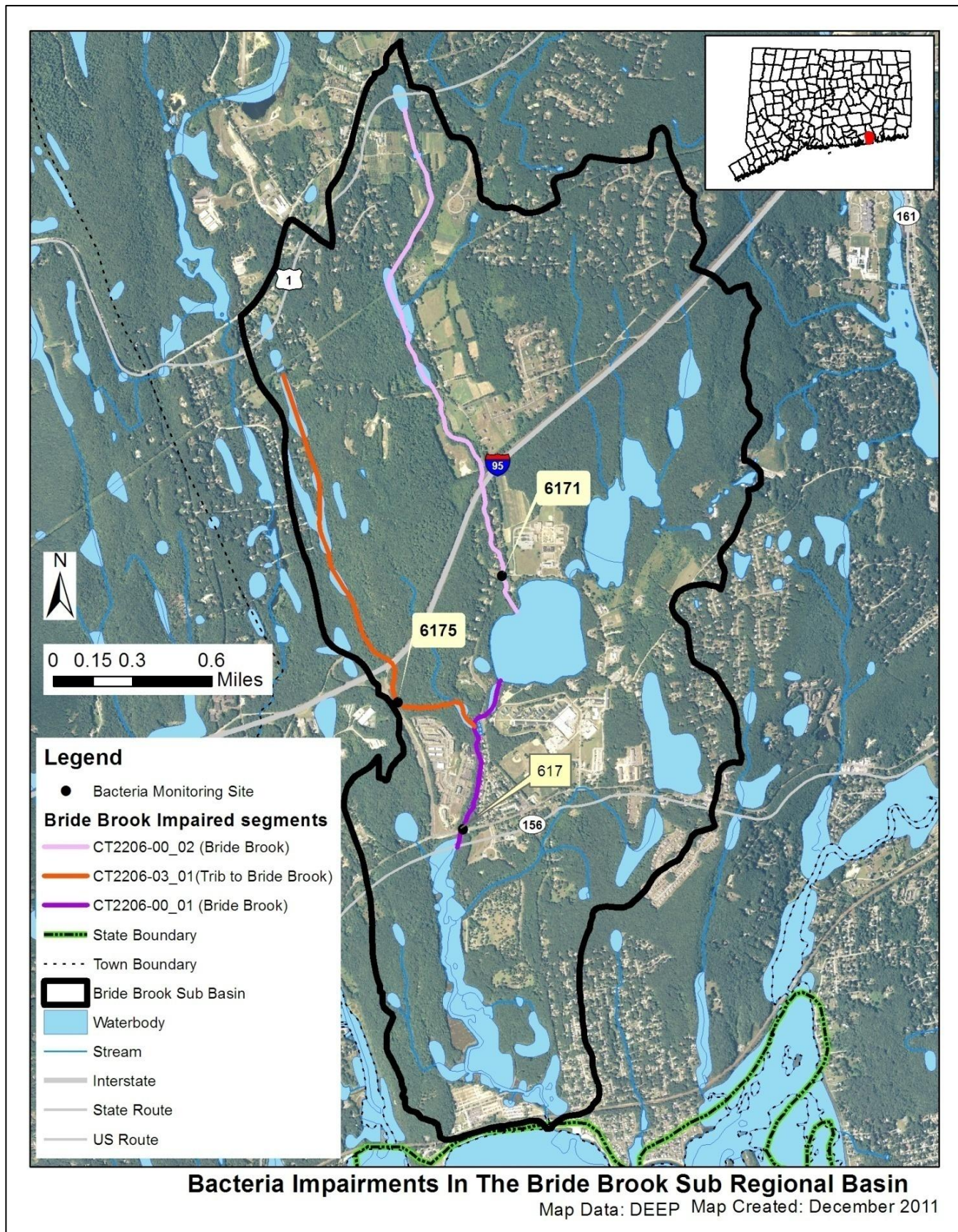
**FULL = Designated Use Fully Supported**

**NOT = Designated Use Not Supported**

**U = Unassessed**



Figure 2: GIS map featuring general information of the Bride Brook watershed at the sub-regional level



### *Land Use*

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Bride Brook watershed consists of 51% forest, 28% urban area, 13% water, and 7% agriculture. Nearly the entire length of Bride Brook (Segment 1) is dominated by urban land use with a few small forested pockets close to the brook. The land surrounding Bride Brook (Segment 2) is a mix of forested, urban, and agricultural land uses. There are several stretches of Bride Brook (Segment 2) where agricultural lands are close to the brook along N. Bride Brook Road in East Lyme. The majority of the land use surrounding Bride Brook (Unnamed Tributary) is forested. However, there are several places where urban land uses are close to Bride Brook (Unnamed Tributary) (Figure 4).

**Figure 3: Land use within the Bride Brook watershed**

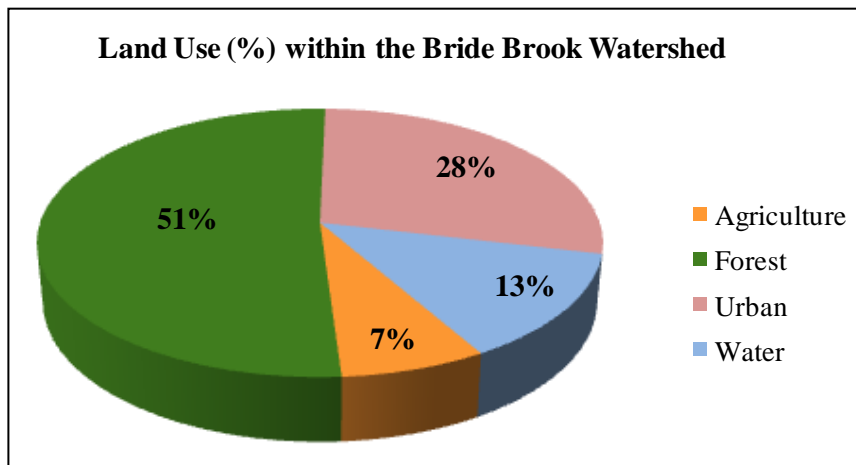
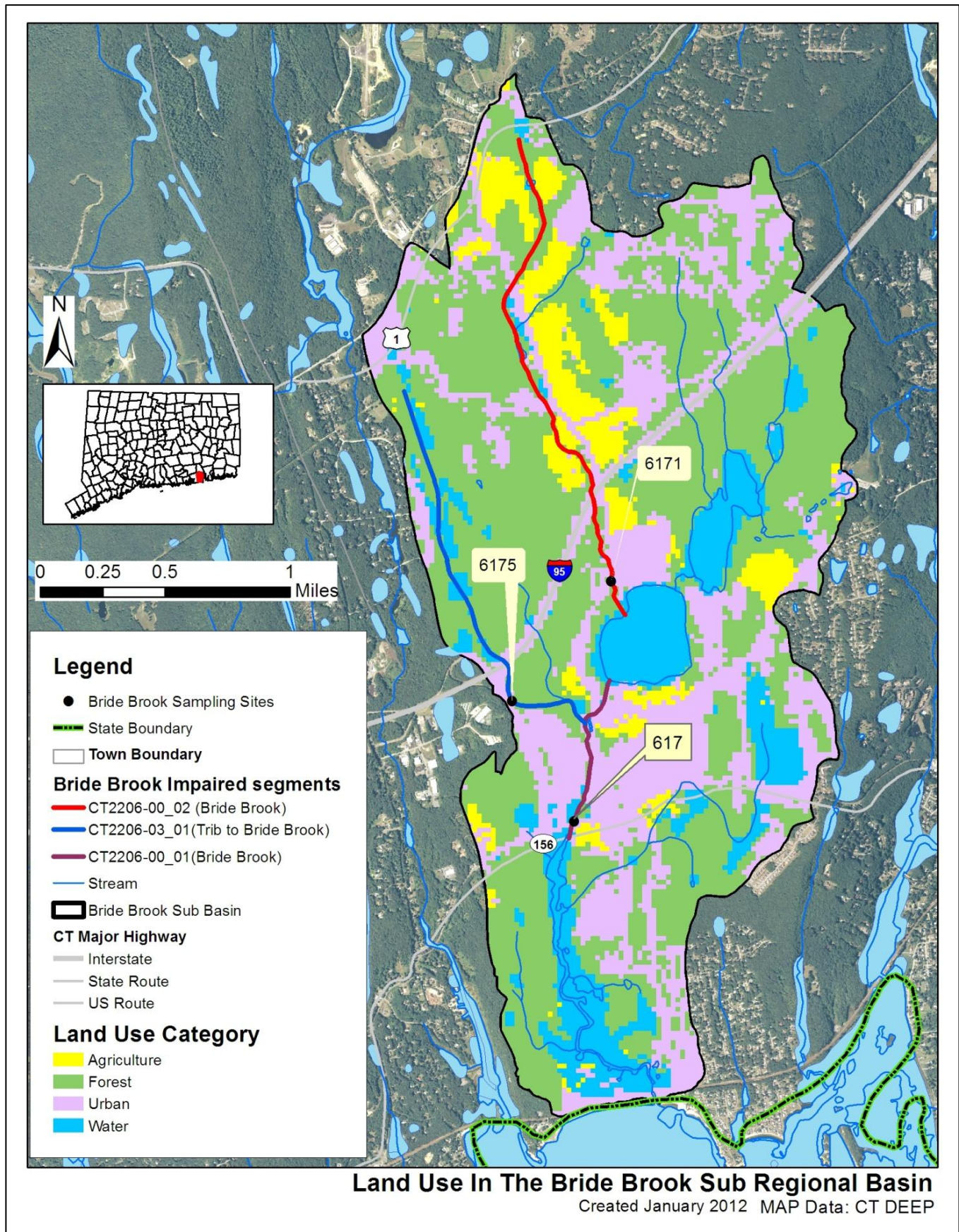




Figure 4: GIS map featuring land use for the Bride Brook watershed at the sub-regional level



**WHY IS A TMDL NEEDED?**

*E. coli* is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

**Table 2: Sampling station location description for the impaired segment in the Bride Brook Watershed (stations organized downstream to upstream)**

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT2206-00_01	Bride Brook (Segment 1)	617	Rte. 156	East Lyme	41.316922	-72.243383
CT2206-00_02	Bride Brook (Segment 2)	6171	At inlet to Brides Lake	East Lyme	41.33087	-72.24043
CT2206-03_01	Bride Brook (Unnamed Tributary)	6175	downstream of 95 north on-ramp	East Lyme	41.32395	-72.2481

Bride Brook (Segment 1) (CT2206-00\_01), Bride Brook (Segment 2) (CT2206-00\_02), and Bride Brook (Unnamed Tributary) (CT2206-03\_01) are Class A freshwater streams (Figure 5). Their applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location on Bride Brook (Segment 1) (Station 617) from 2000-2002, from one sampling location on Bride Brook (Segment 2) (Station 6171) from 2010-2011, and from one sampling location on Bride Brook (Unnamed Tributary) (Station 6175) from 2010-2011 (Table 2).

The *E.coli* water quality criteria and sampling results are presented in Table 8 for Bride Brook (Segment 1), Table 9 for Bride Brook (Segment 2), and Table 10 for Bride Brook (Unnamed Tributary). For Station 617 on Bride Brook (Segment 1), single sample results exceeded the water quality standard (WQS) for *E. coli* one time in 2002. Annual geometric means were calculated for Station 617 and did not exceed the WQS for *E. coli* in 2001. The annual geometric mean could not be calculated for 2000 or 2002 as there was only one sample taken in each of these years at Station 617. For Station 6171 on Bride Brook (Segment 2), single sample results exceeded the WQS for *E. coli* multiple times in 2010 and 2011. Annual geometric means were calculated for Station 6171 and exceeded the WQS for *E. coli* in both 2010 and 2011. For Station 6175 on Bride Brook (Unnamed Tributary), single sample results exceeded the WQS for *E. coli* multiple times in 2011. Annual geometric means were calculated for Station 6171 and exceeded the WQS for *E. coli* in 2011.

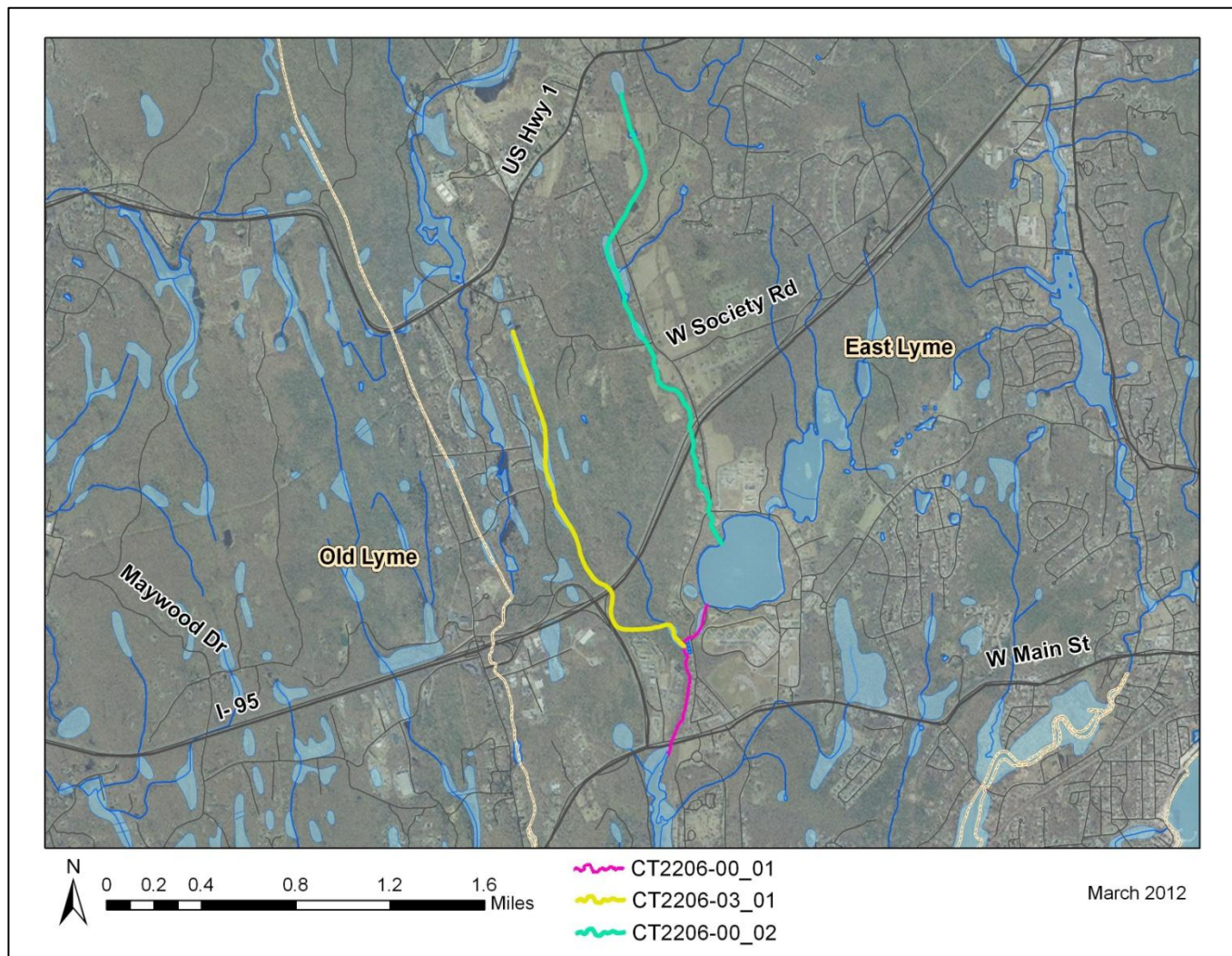
To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days (Tables 8-10). For Stations 6171 and 6175 on Bride Brook (Segment 2) and Bride Brook (Unnamed Tributary), the geometric mean during both wet and dry-weather exceeded the WQS for *E. coli*. Geometric means for Station 617 on Bride Brook (Segment 1) did not exceed the WQS for *E. coli*.

Due to the elevated bacteria measurements presented in Tables 8-10, these impaired segments did not meet CT's bacteria WQS, were identified as impaired, and were placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the



impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

**Figure 5: Aerial map of the Bride Brook Watershed**



**POTENTIAL BACTERIA SOURCES**

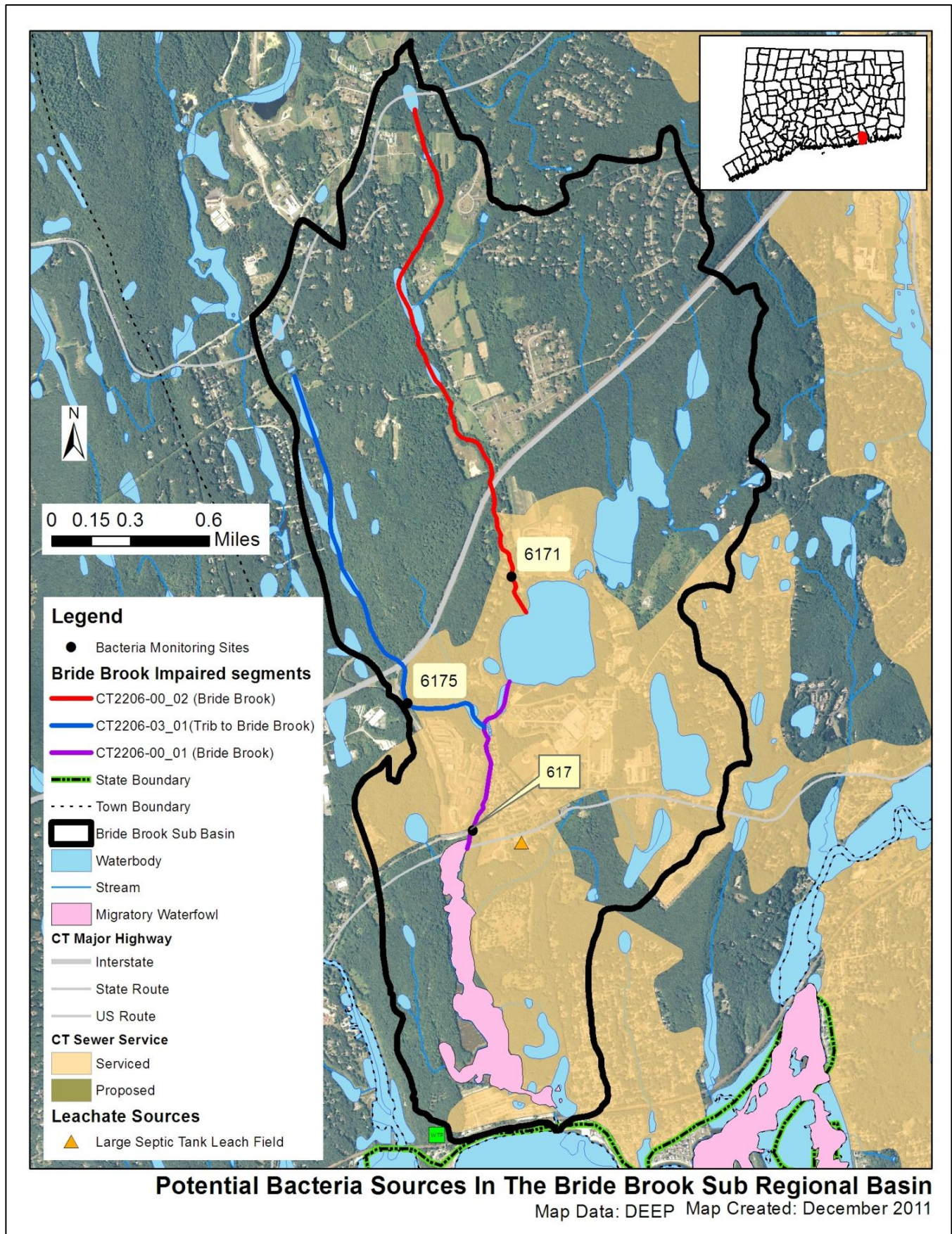
Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

**Table 3: Potential bacteria sources in the Bride Brook watershed**

<b>Impaired Segment</b>	<b>Permit Source</b>	<b>Illicit Discharge</b>	<b>CSO/SSO Issue</b>	<b>Failing Septic System</b>	<b>Agricultural Activity</b>	<b>Stormwater Runoff</b>	<b>Nuisance Wildlife/Pets</b>	<b>Other</b>
Bride Brook (Segment 1) CT7200-00_01	<b>x</b>	<b>x</b>				<b>x</b>	<b>x</b>	
Bride Brook (Segment 2) CT2206-00_02	<b>x</b>	<b>x</b>		<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	
Bride Brook (Unnamed Tributary) CT2206-03_01	<b>x</b>	<b>x</b>		<b>x</b>		<b>x</b>	<b>x</b>	



Figure 6: Potential sources in the Bride Brook watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

### **Point Sources**

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. Additional investigation and monitoring could reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type.

**Table 4: General categories list of other permitted discharges**

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	0
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

### ***Permitted Sources***

There are not currently any permitted discharges within the Bride Brook watershed other than East Lyme's MS4 permit. Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

### ***Municipal Stormwater Permitted Sources***

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All

participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

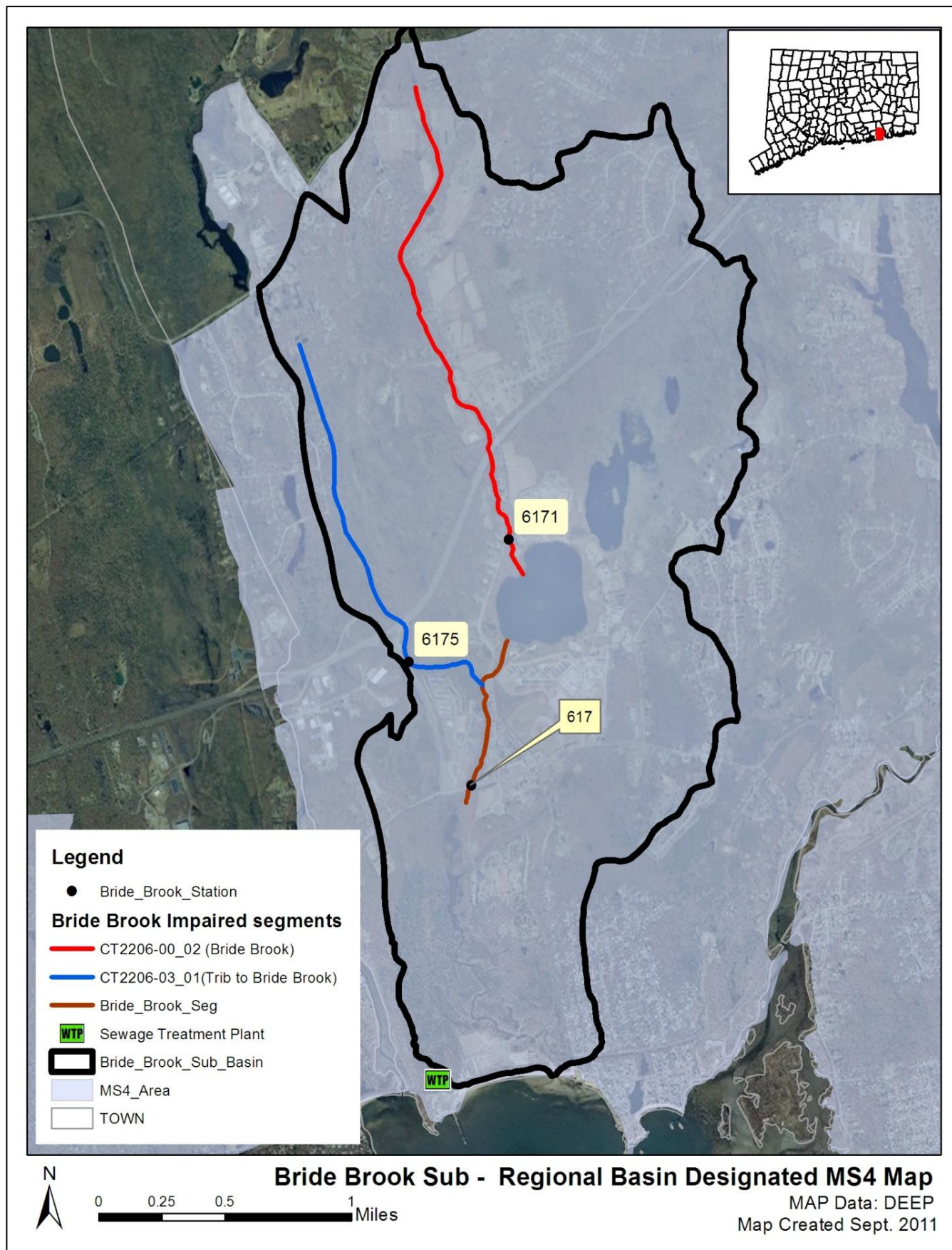
The Bride Brook watershed is located within the Town of East Lyme, CT. Within the watershed area, East Lyme has designated urban areas, as defined by the U.S. Census Bureau, and is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit requires



municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the “TMDL Implementation Guidance” section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP’s website: ([http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav\\_GID=1654](http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654)).

One MS4 outfall has been sampled for *E. coli* bacteria in the watershed in East Lyme in 2006, 2008, and 2010 (Table 5), and bacteria concentrations exceeded the *E. coli* single sample water quality standard of 410 colonies/100 mL on two sample dates. In all, two out of the six (33%) samples from this outfall exceeded the single sample WQS for *E. coli*.

Figure 7: MS4 areas of the Bride Brook watershed



**Table 5: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Bride Brook watershed**

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
East Lyme	Liberty Way	Industrial	Bride Brook	05/02/06	320
East Lyme	Liberty Way	Industrial	Bride Brook	07/12/06	480
East Lyme	Liberty Way	Industrial	Bride Brook	12/13/06	40
East Lyme	Liberty Way	Industrial	Bride Brook	05/08/08	0
East Lyme	Liberty Way	Industrial	Bride Brook	08/06/08	540
East Lyme	Liberty Way	Industrial	Bride Brook	05/12/10	250
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

### ***Publicly Owned Treatment Works***

As seen in Figure 7, there is a wastewater treatment plant located just outside of the Bride Brook watershed. Since the treatment plant is located outside of the watershed and nowhere near any of the impaired segments, no bacteria data from this plant is included in the summary for the Bride Brook watershed.

### **Non-point Sources**

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Bride Brook watershed are described below.

### ***Insufficient Septic Systems and Illicit Discharges***

As shown in Figure , there are portions of the Bride Brook watershed near Bride Brook (Segment 2) and Bride Brook (Unnamed Tributary) that rely on onsite wastewater treatment systems, such as septic systems. Properly managed septic systems and leach fields have the ability to effectively remove bacteria from waste. If systems are not maintained, waste will not be adequately treated and may result in bacteria reaching nearby surface and ground water. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. East Lyme does not have a specific health director, but is part of the Ledge Light health district (<http://ledgelighthd.org/>).

There are multiple areas within the watershed with access to a sanitary sewer. The entire area surrounding Bride Brook (Segment 1) is serviced by a sanitary sewer. The downstream portions of Bride Brook (Segment 2) and Bride Brook (Unnamed Tributary) also have access to a sanitary sewer. Sewer system leaks and other illicit discharges that are located within the watershed near Bride Brook (Segment 1), Bride Brook (Segment 2), and Bride Brook (Unnamed Tributary), could be contributing bacteria to these waterbodies.



***Stormwater Runoff from Developed Areas***

The majority of the northern portion of the Bride Brook watershed, surrounding the upstream portions of Bride Brook (Segment 2) and the Bride Brook (Unnamed Tributary), is undeveloped. However, approximately 28% of the land use in the watershed is considered urban, and this area is concentrated around all of Bride Brook (Segment 1) and the downstream portions of Bride Brook (Segment 2) and Bride Brook (Unnamed Tributary) (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

The majority of the Bride Brook watershed has less than 6% impervious surfaces (Figure 8). However, portions of the watershed near the southern section of the watershed have a higher percentage of impervious cover. In particular, the portion of the watershed surrounding Bride Brook (Segment 1) in East Lyme, to the south of I-95, has an impervious cover consistently between 7 – 11%, indicating that stormwater runoff in these portions of the watershed may be a source of bacteria to the impaired segments (Figure 9).

**Figure 8: Range of impervious cover (%) in the Bride Brook watershed**

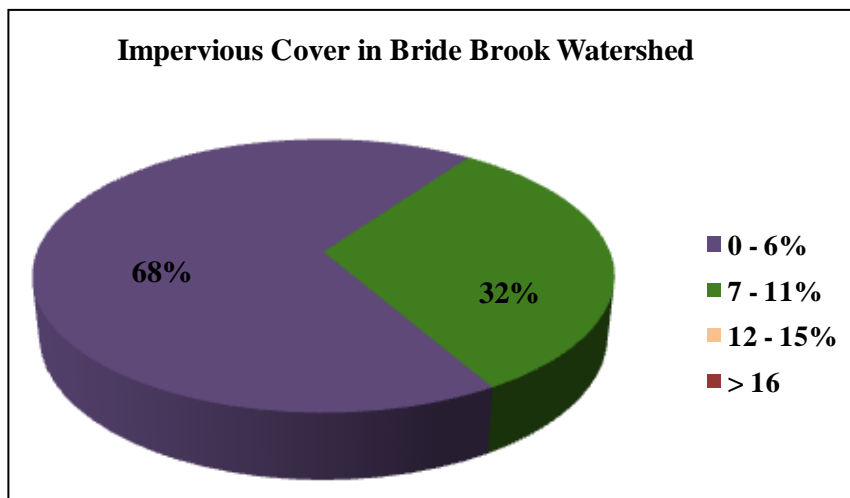
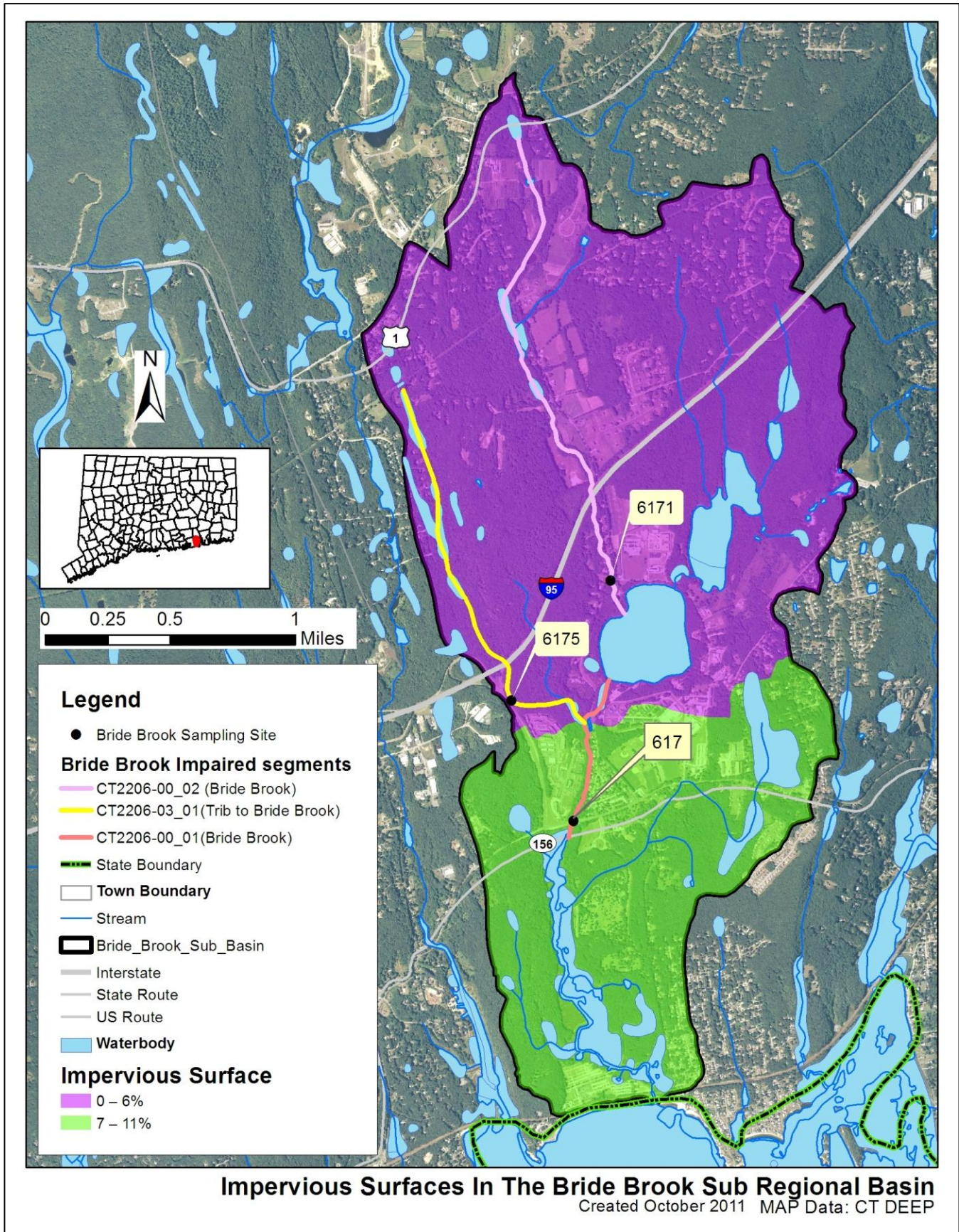


Figure 9: Impervious cover (%) for the Bride Brook sub-regional watershed



***Wildlife and Domestic Animal Waste***

Wildlife and domestic animals within the Bride Brook watershed represent another potential source of bacteria to the impaired waterbodies. Elevated bacteria levels that are due solely to a natural population of wildlife are not subject to the WQS. Any exacerbation of wildlife population sizes or residency times influenced by human activities are subject to the CT WQS and TMDL provisions.

With the construction of roads and drainage systems, these wildlife wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface waterbody. As such these physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001). As the majority of the watershed is undeveloped, wildlife waste is a potential source of bacteria in the Bride Brook watershed.

Geese and other waterfowl are known to congregate in open areas including recreational fields, agricultural crop fields, and golf courses. There are multiple agricultural fields adjacent to Bride Brook (Segment 2) along N. Bride Brook Road. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

There is residential development in the watershed located near Bride Brook (Segment 1) off Atwood Drive and near Bride Brook (Unnamed Tributary) off Spring Rock Road. Unmanaged waste from domestic animals such as dogs, may also be contributing to bacteria concentrations in this impaired segment in the Bride Brook watershed, either from neighborhoods or nearby open spaces that are popular destinations for pets and their owners.

***Agricultural Activities***

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). There are several agricultural fields located adjacent to Bride Brook (Segment 2) off N. Bride Brook Road in East Lyme (Figure 4). Agricultural runoff from these farms and others in the area is a potential source of bacteria to Bride Brook (Segment 2).

**Additional Sources**

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Bride Brook watershed. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.



## **Land Use/Landscape**

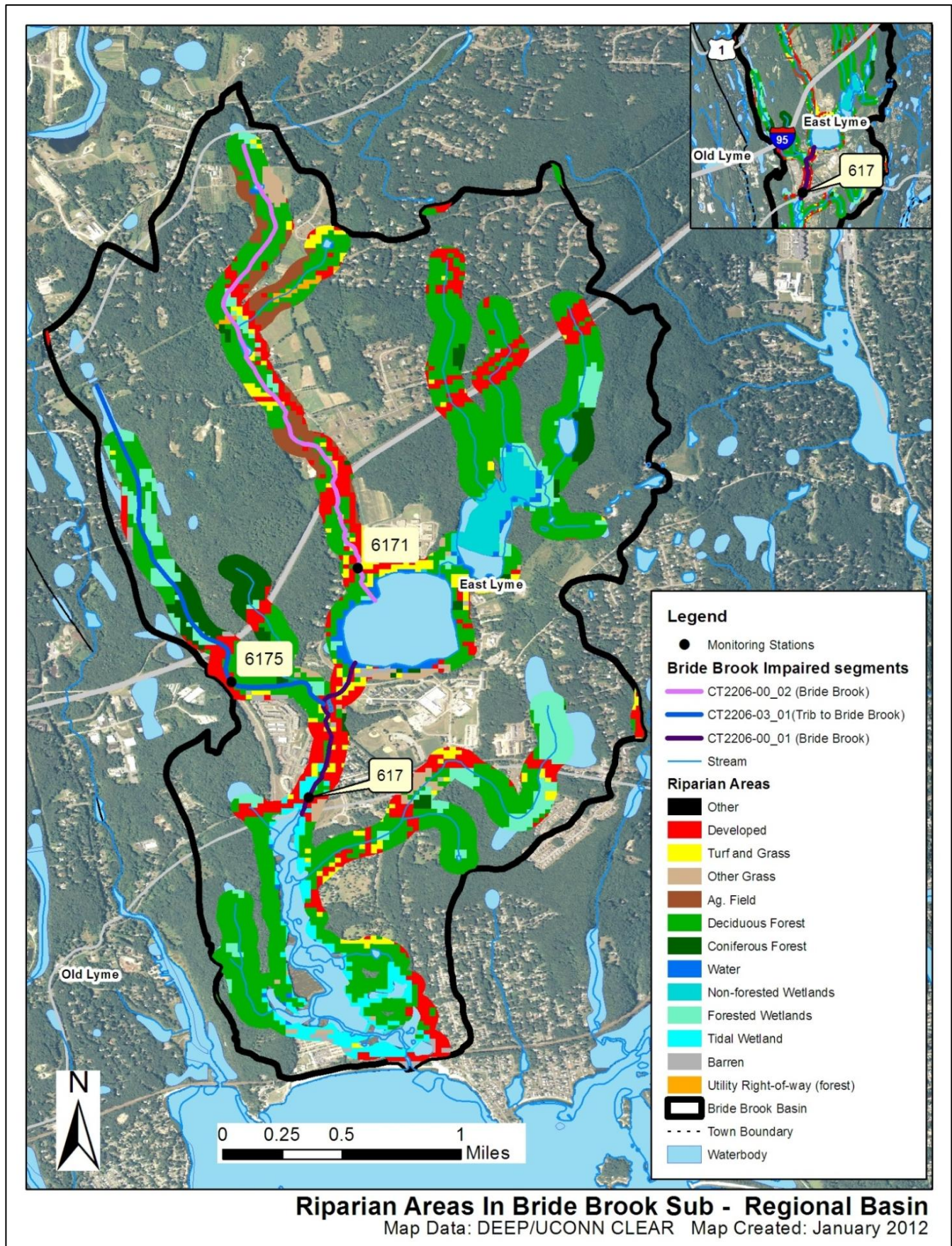
### ***Riparian Buffer Zones***

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (<http://clear.uconn.edu/>), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The riparian zone of Bride Brook (Segment 1) is dominated by developed land uses (Figure 10). The riparian zone of Bride Brook (Segment 2) is characterized by a mix of agricultural, forested, and developed land uses. The riparian zone of the upstream portions of Bride Brook (Unnamed Tributary) is dominated by forest, while some portions of the downstream reach of Bride Brook (Unnamed Tributary) are characterized by developed land uses (Figure 10). Developed areas within the riparian zone likely contribute pollutants such as bacteria to the waterbody since the natural riparian buffer is not available to treat runoff. Agricultural areas within the riparian zone reduce the ability of vegetation to remove pollutants, including bacteria. As previously mentioned, developed and agricultural areas can be sources of bacterial contamination, particularly when directly affecting the riparian zone.

Figure 10: Riparian buffer zone information for the Bride Brook watershed





**CURRENT MANAGEMENT ACTIVITIES**

As indicated previously, the Town of East Lyme is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each town is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Table 6.

**Table 6: Summary of MS4 requirement updates related to the reduction of bacterial contamination from East Lyme, CT (Permit # GSM000032)**

<b>Minimum Measure</b>	<b>East Lyme Stormwater Management Plan (2008 Annual Report)</b>
Public Outreach and Education	<ol style="list-style-type: none"> <li>1) Developing pamphlets, brochures to distributed to town citizens.</li> <li>2) In the process of implementing previously developed program for education outreach.</li> </ol>
Public Involvement and Participation	<ol style="list-style-type: none"> <li>1) Storm drain markings completed for about 1/24 of town's catch basins.</li> <li>2) Developing a program using volunteers for water quality monitoring.</li> </ol>
Illicit Discharge Detection and Elimination	<ol style="list-style-type: none"> <li>1) Continuing to develop illicit discharge detection and elimination program.</li> <li>2) Continuing to develop maps showing all stormwater discharges</li> <li>3) Continuing to design a training program for employees.</li> <li>4) Beginning process of identifying potential sources of illicit discharges.</li> <li>5) Continuing to develop a program for outlet sampling.</li> </ol>
Construction Site Stormwater Runoff Control	<ol style="list-style-type: none"> <li>1) Developing ordinance/regulatory program</li> <li>2) Modified and enforcing town's existing E&amp;S control program.</li> </ol>
Post Construction Stormwater Management	<ol style="list-style-type: none"> <li>1) Continuing to develop BMP standard requirement</li> <li>2) Completed drainage maintenance agreements with developers.</li> </ol>
Pollution Prevention and Good Housekeeping	<ol style="list-style-type: none"> <li>1) Continuing to develop a training program for employees.</li> <li>2) Developed and implemented street sweeping program.</li> </ol>



### RECOMMENDED NEXT STEPS

East Lyme has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the Bride Brook watershed and have been prioritized below.

#### **1) Identify areas in the Bride Brook watershed to implement Best Management Practices (BMPs) to control stormwater runoff.**

As noted previously, 28% of the Bride Brook watershed is considered urban, and East Lyme is an MS4 community regulated by the MS4 program. Portions of the watershed have an impervious cover between 7 – 11%. As such, stormwater runoff is likely contributing bacteria to the waterbodies, particularly in the southern portions of the watershed near the downstream reaches of the impaired segments.

To identify other areas that are contributing bacteria to the impaired segments, East Lyme should continue to conduct wet-weather sampling at stormwater outfalls that discharge directly to the impaired segments in the Bride Brook watershed. Outfalls that have previously shown high bacteria concentrations should be prioritized for BMP installation (Table 5). To treat stormwater runoff, the towns should identify areas along the more developed sections of the impaired segments to install BMPs that encourage stormwater to infiltrate into the ground before entering the waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the river. More detailed information and BMP recommendations can be found in the core TMDL document.

#### **2) Ensure there are sufficient buffers on agricultural lands along the Bride Brook.**

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to those agricultural operations located within the riparian buffer zone of Bride Brook (Segment 2) (Figure 10).

#### **3) Continue monitoring of permitted sources.**

As shown in Table 5, the MS4 outfall sampled in East Lyme exceeded the WQS for *E. coli* on several sample dates. Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan

components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 7 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Bride Brook watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

**Table 7. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use**

Class	Bacteria Source	Instantaneous <i>E. coli</i> (#/100mL)						Geometric Mean <i>E. coli</i> (#/100mL)	
		WLA <sup>6</sup>			LA <sup>6</sup>			WLA <sup>6</sup>	LA <sup>6</sup>
	Recreational Use	1	2	3	1	2	3	All	All
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235 <sup>7</sup>	410 <sup>7</sup>	576 <sup>7</sup>				126 <sup>7</sup>	
	Stormwater (non-MS4)				235 <sup>7</sup>	410 <sup>7</sup>	576 <sup>7</sup>		126 <sup>7</sup>
	Wildlife direct discharge				235 <sup>7</sup>	410 <sup>7</sup>	576 <sup>7</sup>		126 <sup>7</sup>
	Human or domestic animal direct discharge <sup>5</sup>				235	410	576		126

- (1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.
- (2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.
- (3) **All Other Recreational Uses.**
- (4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)
- (5) Human direct discharge = swimmers

- (6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations
- (7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

#### **4) Implement a program to evaluate the sanitary sewer system.**

Many of the residents and businesses surrounding all of Bride Brook (Segment 1) and the downstream portions of Bride Brook (Segment 2) and Bride Brook (Unnamed Tributary) rely on a municipal sewer system (Figure 8). Since the sanitary sewer surrounds these impaired segments, ensuring there are no leaks or overflows from the sanitary sewer in this area should be made a priority. It is important for East Lyme to continue to develop programs to evaluate its sanitary sewer and reduce leaks and overflows, especially in the areas around this impaired segment. This program should include periodic inspections of the sewer line.

#### **5) Develop a system to monitor septic systems.**

Many of the residents in the Bride Brook watershed rely on septic systems, specifically in the upstream portions of Bride Brook (Segment 2) and Bride Brook (Unnamed Tributary). If not already in place, East Lyme should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems. Particular attention should be paid to the large septic tank/leachfield identified in the southern portion of the watershed in East Lyme near W. Main Street.

#### **6) Evaluate municipal education and outreach programs regarding animal waste.**

As most of the Bride Brook watershed is undeveloped, any education and outreach program should highlight the importance of not feeding waterfowl and wildlife and managing waste from horses, dogs, and other pets. The town and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the impaired segments that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Bride Brook watershed and can harm human health and the environment.

Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.



**BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL****Table 8: Bride Brook (Segment 1) Bacteria Data****Waterbody ID:** CT2206-00\_01**Characteristics:** Freshwater, Class A, Potential Drinking Water Supplies, Habitat for Fish and Other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

**Percent Reduction to meet TMDL:**

Geometric Mean: NA

Single Sample: 7%

**Data:** 2000 – 2002 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* data from all monitoring stations on the Bride Brook (Segment 1) with annual geometric means calculated**

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
617	Route 156	10/31/2000	20	dry**	NA
617	Route 156	2/22/2001	330	dry	118*
617	Route 156	5/8/2001	41	dry**	
617	Route 156	7/31/2001	120	dry	
617	Route 156	8/1/2002	440* (7%)	dry	NA
Shaded cells indicate an exceedance of water quality criteria					
*Indicates single sample and geometric mean values used to calculate the percent reduction					
** Weather conditions for selected data taken from Hartford because local station had missing data					

**Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on Bride Brook (Segment 1)**

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
617	Route 156	2000-2002	0	5	107	NA	107
Shaded cells indicate an exceedance of water quality criteria							
Weather condition determined from rain gages in Groton, CT and at Hartford Bradley International Airport							

**Table 9: Bride Brook (Segment 2) Bacteria Data****Waterbody ID:** CT2206-00\_02**Characteristics:** Freshwater, Class A, Potential Drinking Water Supplies, Habitat for Fish and Other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

**Percent Reduction to meet TMDL:**Geometric Mean: **81%**Single Sample: **98%****Data:** 2010 – 2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* data from all monitoring stations on the Bride Brook (Segment 2) with annual geometric means calculated**

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
6171	at inlet to Brides Lake	7/15/2010	660	wet	<b>651* (81%)</b>
6171	at inlet to Brides Lake	7/19/2010	<b>24001*</b> <b>(98%)</b>	wet	
6171	at inlet to Brides Lake	7/21/2010	560	wet	
6171	at inlet to Brides Lake	7/26/2010	420	wet	
6171	at inlet to Brides Lake	8/2/2010	280	dry	
6171	at inlet to Brides Lake	8/9/2010	250	dry	
6171	at inlet to Brides Lake	8/16/2010	2000	wet	
6171	at inlet to Brides Lake	8/18/2010	380	dry	
6171	at inlet to Brides Lake	8/23/2010	3100	wet	
6171	at inlet to Brides Lake	8/25/2010	350	dry	
6171	at inlet to Brides Lake	8/30/2010	220	dry	
6171	at inlet to Brides Lake	8/30/2010	250	dry	
6171	at inlet to Brides Lake	9/14/2010	320	dry	

**Single sample data from all monitoring stations on the Bride Brook (Segment 2) with annual geometric means calculated (continued)**

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
6171	at inlet to Brides Lake	6/9/2011	370	wet**	448
6171	at inlet to Brides Lake	6/15/2011	360	wet**	
6171	at inlet to Brides Lake	6/23/2011	270	wet**	
6171	at inlet to Brides Lake	6/27/2011	240	dry**	
6171	at inlet to Brides Lake	6/29/2011	1900	wet**	
6171	at inlet to Brides Lake	7/5/2011	120	dry**	
6171	at inlet to Brides Lake	7/11/2011	170	dry**	
6171	at inlet to Brides Lake	7/18/2011	300	dry**	
6171	at inlet to Brides Lake	7/21/2011	210	dry**	
6171	at inlet to Brides Lake	7/25/2011	500	wet**	
6171	at inlet to Brides Lake	8/1/2011	790	dry**	
6171	at inlet to Brides Lake	8/8/2011	1100	wet**	
6171	at inlet to Brides Lake	8/10/2011	1300	wet**	
6171	at inlet to Brides Lake	8/15/2011	1600	wet**	
6171	at inlet to Brides Lake	8/17/2011	350	dry**	
6171	at inlet to Brides Lake	8/22/2011	400	dry**	
Shaded cells indicate an exceedance of water quality criteria					
†Average of two duplicate samples					
** Weather conditions for selected data taken from Hartford because local station had missing data					
*Indicates single sample and geometric mean values used to calculate the percent reduction					

**Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on Bride Brook (Segment 2)**

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
6171	at inlet to Brides Lake	2010-2011	14	15	530	1043	282
<b>Shaded cells indicate an exceedance of water quality criteria</b> <b>Weather condition determined from rain gages in Groton, CT.</b>							



**Table 10: Bride Brook (Unnamed Tributary) Bacteria Data****Waterbody ID:** CT2206-03\_01**Characteristics:** Freshwater, Class A, Potential Drinking Water Supplies, Habitat for Fish and Other Aquatic Life and Wildlife, Recreation, Navigation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

**Percent Reduction to meet TMDL:**Geometric Mean: **71%**Single Sample: **95%****Data:** 2010 – 2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* data from all monitoring stations on the Bride Brook (Unnamed Tributary) with annual geometric means calculated**

Station Name	Station Location	Date	Result	Wet/Dry	Geomean
6175	Downstream of US Route 95 North on ramp	8/18/2010	380	dry	NA
6175	Downstream of US Route 95 North on ramp	6/9/2011	10	wet**	<b>434*</b> <b>(71%)</b>
6175	Downstream of US Route 95 North on ramp	6/15/2011	180	wet**	
6175	Downstream of US Route 95 North on ramp	6/23/2011	520	wet**	
6175	Downstream of US Route 95 North on ramp	6/27/2011	140	dry**	
6175	Downstream of US Route 95 North on ramp	6/29/2011	<b>6600*</b> <b>(94%)</b>	wet**	
6175	Downstream of US Route 95 North on ramp	7/5/2011	320	dry**	
6175	Downstream of US Route 95 North on ramp	7/11/2011	300	dry**	
6175	Downstream of US Route 95 North on ramp	7/18/2011	540	dry**	
6175	Downstream of US Route 95 North on ramp	7/21/2011	74	dry**	
6175	Downstream of US Route 95 North on ramp	7/25/2011	260	wet**	
6175	Downstream of US Route 95 North on ramp	8/1/2011	150	dry**	
6175	Downstream of US Route 95 North on ramp	8/8/2011	2200	wet**	
6175	Downstream of US Route 95 North on ramp	8/10/2011	5800	wet**	
6175	Downstream of US Route 95 North on ramp	8/15/2011	1700	wet**	
6175	Downstream of US Route 95 North on ramp	8/17/2011	630	dry**	
6175	Downstream of US Route 95 North on ramp	8/22/2011	880	dry**	

**Shaded cells indicate an exceedance of water quality criteria****†Average of two duplicate samples****\*\* Weather conditions for selected data taken from Hartford because local station had missing data****\*Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for all monitoring stations on the Bride Brook (Unnamed Tributary)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
6175	Downstream of US Route 95 North on ramp	2010-2011	8	9	430	657	295
Shaded cells indicate an exceedance of water quality criteria Weather condition determined from rain gages in Groton, CT.							

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